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Maritimes Region
Canadian Science Advisory Secretariat
Science Response 2014/029

4VWX HERRING 2014 UPDATE REPORT

Context

Maritimes DFO Resource Management has requested that DFO Science provide an update on the science advice for 4VWX Atlantic Herring (*Clupea harengus*) management unit in support of the 2013/2014 fishery. The last assessment of 4VWX herring was conducted in March 2013 (DFO 2013). The biological and fishery information of the 4VWX herring forms the basis for establishing quota for the 2013/2014 fisheries, as required in the Integrated Fisheries Management Plan (IFMP). This response reviews and updates biological and fishery information on 4VWX herring stock including an evaluation of the southwest Nova Scotia / Bay of Fundy spawning component, a compilation and review of information regarding the offshore Scotian Shelf spawning component and the coastal Nova Scotia spawning component, an update on southwest New Brunswick migrant juvenile fishery component, and an evaluation of the status of the fishery with respect to the conservation Limit Reference Point. In addition, it provides advice on the recovery and rebuilding of 4VWX herring, and reviews whether the goals of the rebuilding plan are being met.

The 2003 (Evergreen) Scotia-Fundy Herring IFMP set out principles, conditions, and management measures for the 4VWX herring fisheries (DFO 2003). The main principle stated in the plan is "the conservation of the herring resource and the preservation of all of its spawning components". The three conservation objectives are: to maintain the reproductive capacity of herring in each management unit, to prevent growth overfishing, and to maintain ecosystem integrity/ecological relationships ("ecosystem balance"). Progress against these conservation objectives was evaluated in the March 2013 assessment (DFO 2013). A major review of the assessment framework was conducted in 2006/07 (DFO 2007) followed by a framework meeting in 2011. No model was chosen but recommendations for the assessment were provided in the report (DFO 2011). In 2012, a conservation limit reference point of 377,272t, the average spawning biomass in Scots Bay and German Bank for the period 2005-2010, was set (Clark et al. 2012). The total spawning biomass in these two areas is evaluated based on the three-year moving average with respect to this limit reference point.

This Science Response Report results from the Science Response Process March 2014, on the "Update of 4VWX Herring".

Background

The 4VWX herring management unit contains a number of spawning areas, separated to various degrees in space and time. For the purposes of evaluation and management, the 4VWX herring fisheries are divided into four components (see the Appendix for map of place names): (i) Southwest (SW) Nova Scotia / Bay of Fundy spawning component (includes Scots Bay, German Bank and Trinity Ledge); (ii) Offshore Scotian Shelf spawning component (includes The Patch and Western Hole); (iii) Coastal (South Shore, Eastern Shore and Cape Breton) Nova Scotia spawning component; and (iv) SW New Brunswick (NB) migrant juveniles (NB weirs). Each component except southwest New Brunswick migrant juveniles has several spawning areas, and there is mixing of fish among spawning components outside of the spawning period. The fisheries in 4VWX have been dominated by purse seine (84-90%), followed by weir, gillnet, shutoff and trap.

Analysis and Response

Fishery

The landings for the period October 15, 2012, to October 14, 2013, (the 2012/2013 quota year) were 46,601 t against a Total Allowable Catch (TAC) of 50,000 t for the SW Nova Scotia/Bay of Fundy component (Table 1). The TAC was not completely taken due to late quota transfers and bad weather near the end of the season in 2013.

Table 1. Reported landings (thousands of tonnes) and TAC for the 4WX herring management unit by component from 2006 to 2013 with averages for recent and prior decades.

Year	Average 1970-79	Average 1980-89	Average 1990-99	Average 2000-09	2006	2007	2008	2009	2010	2011	2012	2013
4WX SW Nova Scotia TAC[1]	106	106	112	69	50	50	55	55	55	50	50	50
4WX SW Nova Scotia[1]	131	131	96	66	50	50	55	54	46	50	48	47
4VWX Coastal NS[2]	<1	<1	4	7	7	5	4	10	6	4	3	4
Offshore Scotian Shelf[2]	38	<0.1	13	6	10	5	1	9	12	10	1	2
SW New Brunswick[2]	26	24	24	15	13	31	6	4	11	4	1	6
Total Landings	172	155	137	93	79	92	66	77	74	68	52	58

1 - Quota year from Oct. 15th of the preceding year to Oct. 14th of the current year

2 - Calendar year from Jan. 1st to Dec. 31st

Additional landings of 11,731 t were taken in the non-stock components (outside the quota area) for a total of 58,332 t. Landings in 2013 increased for New Brunswick weirs and shutoffs as well as the Offshore Scotian Shelf and the Coastal Nova Scotia component. There was a decrease in catches from the German Bank fishing grounds from 65% of the total TAC in 2012 to 29% in 2013. In 2013, industry implemented a cap on the German Bank catches at 50% of the TAC. Landings increased in 2013 from Grand Manan, Gannet Dry Ledge, Long Island and New Brunswick Coastal.

The strong age 5 cohort (2008 year-class) continued to show up in 2013 as 5 year olds (13%) (Figures 1 and 2). As was indicated in the last assessment (DFO 2013), the lack of a strong age 2 cohort (2009 year-class) (12%) in 2011, showed up as age 4 (9%) in 2013 and is a cause for concern since they will become the age 5 cohort in 2014. While there appears to be a good percentage of two-year olds in 2012-2013 (35%), they do not appear to be widespread as in 2009-2010. This is similar to the situation in 2011-2012 (DFO 2013). The total number of fish removed by the fishery was calculated to be 455 million in 2013 (up from 432 in 2012).

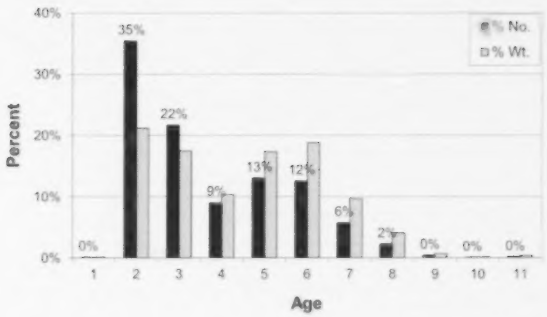

Figure 1. Fishery catch at age (percentage numbers and percentage weight) for SW Nova Scotia/Bay of Fundy spawning component (2012-2013 quota year).

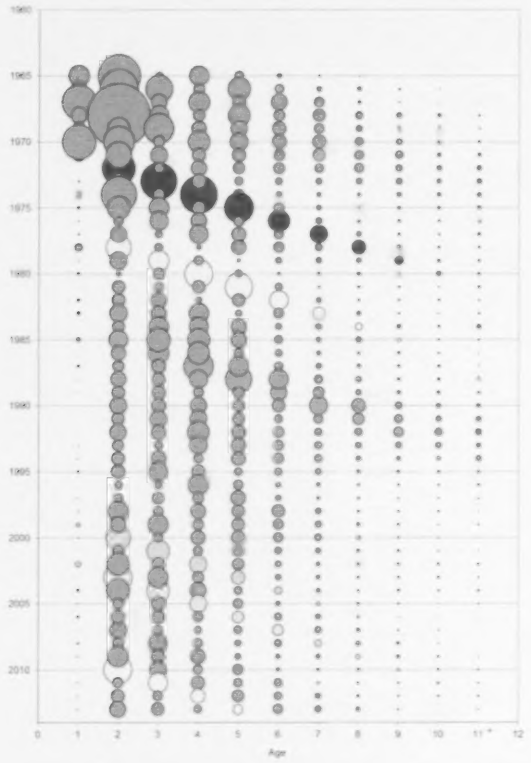

Figure 2. Historical catch at age for SW Nova/Bay of Fundy spawning component from 1965-2013. Selected strong year-classes are indicated by colours.

The acoustic survey catch at age has a broad age distribution of spawning fish from ages 3-11. The proportion of fish at age 6 and older has increased from 15% in 2010 to 35% in 2013 in the acoustic survey catch at age compared with 3% (2010) and 21% (2013) in the fishery. The mean acoustic survey catch at age decreased from 5.1 years in 2012 to 4.8 years in 2013. The mean age in the commercial catch decreased from 3.9 (2012) to 3.7 (2013) indicating the harvesting of younger fish than in 2012.

Acoustic Surveys

Table 2 shows the summary of the results from the 2013 acoustic surveys for the SW Nova Scotia/Bay of Fundy component. Inbox and outbox refers to survey tracks within and outside the designated survey boxes, respectively. There were 7 surveys in Scots Bay, 5 on German Bank and 2 on Trinity Ledge.

Table 2. Acoustic survey spawning biomass index for SW Nova Scotia / Bay of Fundy spawning component for 1999 to 2013 (rounded to thousands of tonnes).

Location/Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Average 2005-2010	Average 1999-2013
Scots Bay (inbox)	46	185	216	129	123	115	21	32	51	23	82	42	106	144	67	42	92
Scots Bay (outbox)									2	0	6	12	35	41	9	11	15
Scots Bay total	46	185	216	129	123	115	21	32	53	23	88	54	141	185	76	45	99
German Bank (inbox)	495	334	257	416	349	392	269	291	495	239	396	235	289	278	254	321	333
German Bank (outbox)								5	4	2	2	19	11	10	11	6	8
German Bank total	495	334	257	416	349	392	269	295	499	241	398	254	300	288	265	326	337
Trinity Ledge	4	1	15	9	12	12	11	16	3	1	2	2	7	3	1	6	7
Spec Buoy (spring)			1		1		1		0	0		2	0			1	1
Spec Buoy (fall)			88					0								0	44
Overall Stock Area	545	521	577	554	485	519	301	343	556	265	487	312	449	476	342	377	449
Seal Island			4	1	12			10					1			10	6
Browns Bank			45					8								8	26
Total All Areas	545	521	626	556	497	519	301	361	556	265	487	312	450	476	342	380	454

Note: Average 2005-2010 = Limit Reference Point (German Bank and Scots Bay total only)
Blank cells = no data for that year in that category
Zero = surveys conducted but the numbers recorded were either 0 or less than 500t (rounds to 0 thousand t).

The overall acoustic biomass estimates (Scots Bay, Trinity Ledge and German Bank) decreased in 2013 to 341,694t from 476,026t (2012). This moves the overall acoustic biomass estimate to 24% below the long-term average (1999-2013) of 448,756 t. Most of the decrease occurred in Scots Bay (76,218 t in 2013, 184,829 t in 2012). The German Bank spawning stock biomass (SSB) also decreased (264,527 t in 2013, 288,443 t in 2012) essentially representing no change over the past four years.

Limit Reference Point

The three-year moving average for the acoustic survey estimate (Scots Bay and German Bank combined) was calculated to be above the limit reference point in 2012 by 9%. In 2013 this average increased to 11% above the limit reference point (Figure 3). Although the 2013 acoustic survey estimate (340,000 t) decreased, the 3-year moving average increased due to the 2010 SSB estimate (307,800 t) no longer being included in the 3-year moving average.

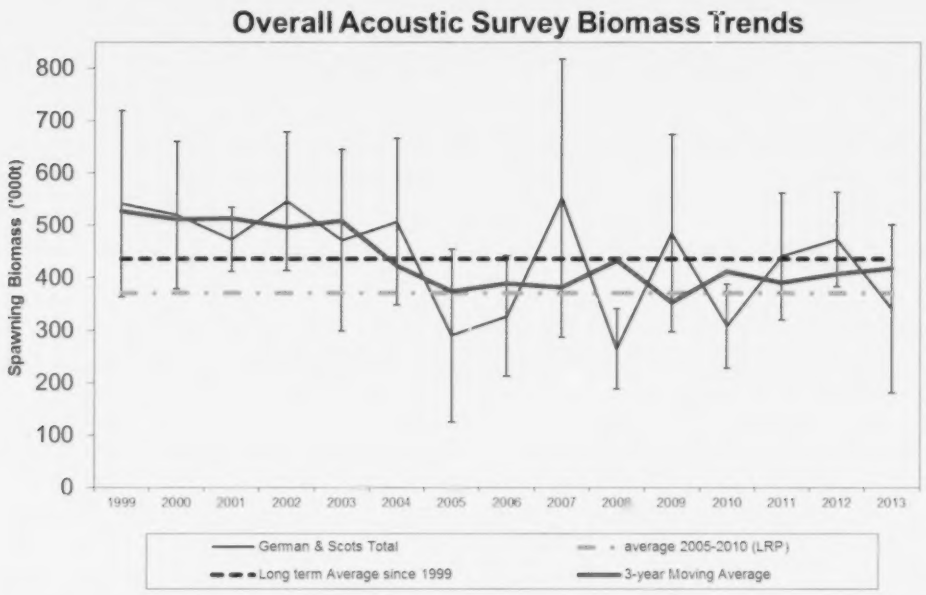

Figure 3. Relative spawning stock biomass index (with 95% standard errors), the calculated three-year moving average, the long-term average and the limit reference point for the SW Nova Scotia/Bay of Fundy spawning component (German Bank and Scots Bay).

Offshore Scotian Shelf Component

In 2013, there was a slight increase in the catches from the offshore (1,466 t; 1,210 t in 2012). Most landings were caught by purse seiners in May and June, in the vicinity of The Patch (see map in the Appendix). In 2013, the age composition of the commercial catch was mostly adult herring with ages 5, 6 and 7 dominating by numbers (74%) and weights (75%). An additional by-catch of 49 t was reported from groundfish otter trawl fisheries and Silver Hake on the Scotian Shelf. The DFO summer research vessel survey mean catch per tow for the 4WX offshore area decreased to 98 fish from 108 in 2012.

Coastal (South Shore, Eastern Shore and Cape Breton) Nova Scotia Spawning Component

Landings and allocations in the Little Hope/Port Mouton area increased in 2013 to 2,492 t (from 2,150 t in 2012) against the initial 2013 allocation of 2,387 t (Table 3). After a substantial increase in the herring surveyed in 2013, the Little Hope Management Committee requested and received an additional 400 t to their original allocation resulting in a final allocation of 2,790 t (Table 3). Landings increased from a low of 799 t (2012) to 1,390 t (2013) against a 2013 allocation of 2,427 t in the Eastern Shore area. Allocations are based on the recent five-year average of observed acoustic biomass. Landings were minimal again for Glace Bay with 2 t reported in 2013. The Bras d'Or Lakes area remained closed to herring fishing. In 2013, the age composition of the catch for the coastal component was primarily adult herring from this size selective gillnet fishery with a substantial proportion of the catch (89% by numbers) age 5 and older.

Table 3. Recorded landings and allocations (tonnes) of herring from major gillnet fisheries on the Coastal Nova Scotia spawning component for 1996 to 2013.

Landings & Allocations (t)		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Little Hope/Port Mouton	Catch	-	490	1,170	2,920	2,040	2,900	3,980	4,500	1,300	2,240	3,140	1,510	1,108	3,731	3,106	2,564	2,150	2,492
	Allocation	-	-	-	-	1,495	1,170	1,410	2,248	3,028	3,162	3,952	4,008	2,994	2,172	2,454	2,094	2,188	2790*
Halifax/ Eastern Shore	Catch	1,280	1,520	1,100	1,630	1,350	1,900	3,330	2,700	4,200	3,450	3,350	3,730	2,381	6,045	2,456	1,040	799	1,390
	Allocation	-	-	-	-	1,425	1,313	1,403	1,952	3,638	3,802	4,323	5,367	5,103	3,857	4,373	4,188	2,920	2,427
Glace Bay	Catch	-	170	1,730	1,040	830	1,200	3,060	1,900	1,500	630	85	45	12	4	11	0	7	2
Bras d'Or Lakes	Catch	170	160	120	30	56	0	1	4	0	0	0	0	0	0	0	0	0	0

*original allocation of 2,387 t was increased by 400 t

In 2013, the survey biomass for the Little Hope/Port Mouton area increased dramatically to 74,532 t from the 12,756 t in 2012, the highest since surveys started and well above the recent 5-year average of 35,877 t (Table 4). The survey biomass in the Halifax/Eastern shore area increased to 6,780 t (2013) from 3,668 t (2012) and remains well below the recent 5-year average of 19,587 t. Only one survey was completed near Glace Bay in 2013, but there were very few spawning herring documented or reported catches.

Table 4. Estimated herring acoustic SSB (tonnes) and recent 5-year average for the Coastal Nova Scotia spawning component areas.

Acoustic Survey SSB (t)	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Avg last 5 year
Little Hope/Port Mouton	14,100	15,800	5,200	21,300	56,000	53,100	22,500	44,700	24,100	2,800	14,500	26,600	26,700	28,796	12,756	74,532	35,877
Little Hope Allocation	-	-	1,495	1,170	1,410	2,248	3,028	3,162	3,952	4,008	2,944	2,172	2,454	2,094	2,188	2,387	
Halifax / Eastern Shore	8,300	20,200	10,900	16,700	41,500	92,600	28,400	36,950	68,900	28,300	30,300	54,200	27,700	5,498	3,668	6,870	19,587
Halifax Allocation	-	-	1,425	1,313	1,403	1,952	3,638	3,802	4,323	5,367	5,103	3,857	4,373	4,188	2,920	2,427	
Glace Bay	0	2,000	0	21,200	7,700	31,500	n/s	3,180	n/s	240	500	100	8	51	n/s	50	52
Bras d'Or Lakes	0	530	70	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	

n/s no survey

SW New Brunswick Migrant Juveniles

The 2013 landings in the New Brunswick weir and shut-off fishery increased to 6,287 t from 504 t in 2012, which was lowest in the history of the fishery. Fish caught in the New Brunswick weir and shutoff fishery were mostly juveniles (20% age 1 and 73% at age 2 by numbers). The number of weirs with catches increased in 2013 to 49 from four in 2012.

Conclusions

SW Nova Scotia / Bay of Fundy Spawning Component

The acoustic spawning stock biomass estimate decreased, reflecting the large decrease in Scots Bay. The German Bank SSB estimate also decreased slightly with no change over the past four years. Despite these decreases, the 3-year moving average increased as the low SSB estimate in 2010 is no longer included. A harvest strategy that continues to exercise caution is appropriate. Table 5 provides a summary of the observations and conclusions for each of the corresponding objectives in the Management Plan.

Table 5. Observations and conclusions on conservation objective elements from the management plan for SW Nova Scotia / Bay of Fundy spawning component in 2013.

Objectives in Management Plan	2013: Observations and Conclusions
Persistence of all spawning components	Spawning observed in Scots Bay and German Bank. Spawning activity could not be determined on Seal Island or Browns due to a lack of fishing or survey effort. Trinity Ledge again had minimal spawning.
Maintain biomass of each component	Acoustic biomass estimates decreased in both Scots Bay and German, greater decrease in Scots Bay. The SSB for Trinity remains well below the long term average.
Maintain broad age composition	An improvement in the range of ages in the commercial catch (1-9), as well as in the acoustic survey catch at age (3-11).
Maintain long spawning period	Start of spawning in 2013 for Scots Bay was earlier than 2012 based on survey results. Spawning in German Bank appeared to start and end about the average in recent years. Virtually no spawning occurred on Trinity Ledge.
Fishing mortality at or below F0.1	Fishing mortality could not be determined. Relative exploitation rates based on acoustic SSB and catch increased in 2013 after decreasing in 2011 and 2012.
Maintain spatial and temporal diversity of spawning	Similar spatial and temporal distribution of spawning on German Bank. Duration of spawning in Scots was extended starting earlier. Trinity spawning is very restricted in space and time. There is no new data to support spawning in other areas.
Maintain biomass at moderate to high levels	There was a decrease in acoustic SSB for both Scots Bay and German Bank compared to 2012. This has resulted in the combined biomass level to drop below the long-term average.
Maintain three-year moving average above the limit reference point	The three-year moving average remains above the limit reference point since 2010 and shows a slightly increasing trend.

Offshore Scotian Shelf Component

There was no new information and no reason to change the recommendation that the initial catch allocation for 2014 should not exceed 12,000 t as described in the DFO management plan (DFO 2003).

Coastal (South Shore, Eastern Shore and Cape Breton) Nova Scotia Spawning Component

As in 2013 (DFO 2013), it is recommended that no coastal spawning group experience a large effort increase in new areas until enough information is available to evaluate the state of that spawning group. It has been noted since 1997 that the status of herring in the Bras d'Or Lakes is cause for concern, but there has been no research or surveying in recent years. It is, therefore, appropriate to reiterate that no fishing should take place on this spawning component. Harvest levels from these areas use a five-year average of survey biomass and/or surveyed acoustic biomass to set initial targets.

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Sources of Information

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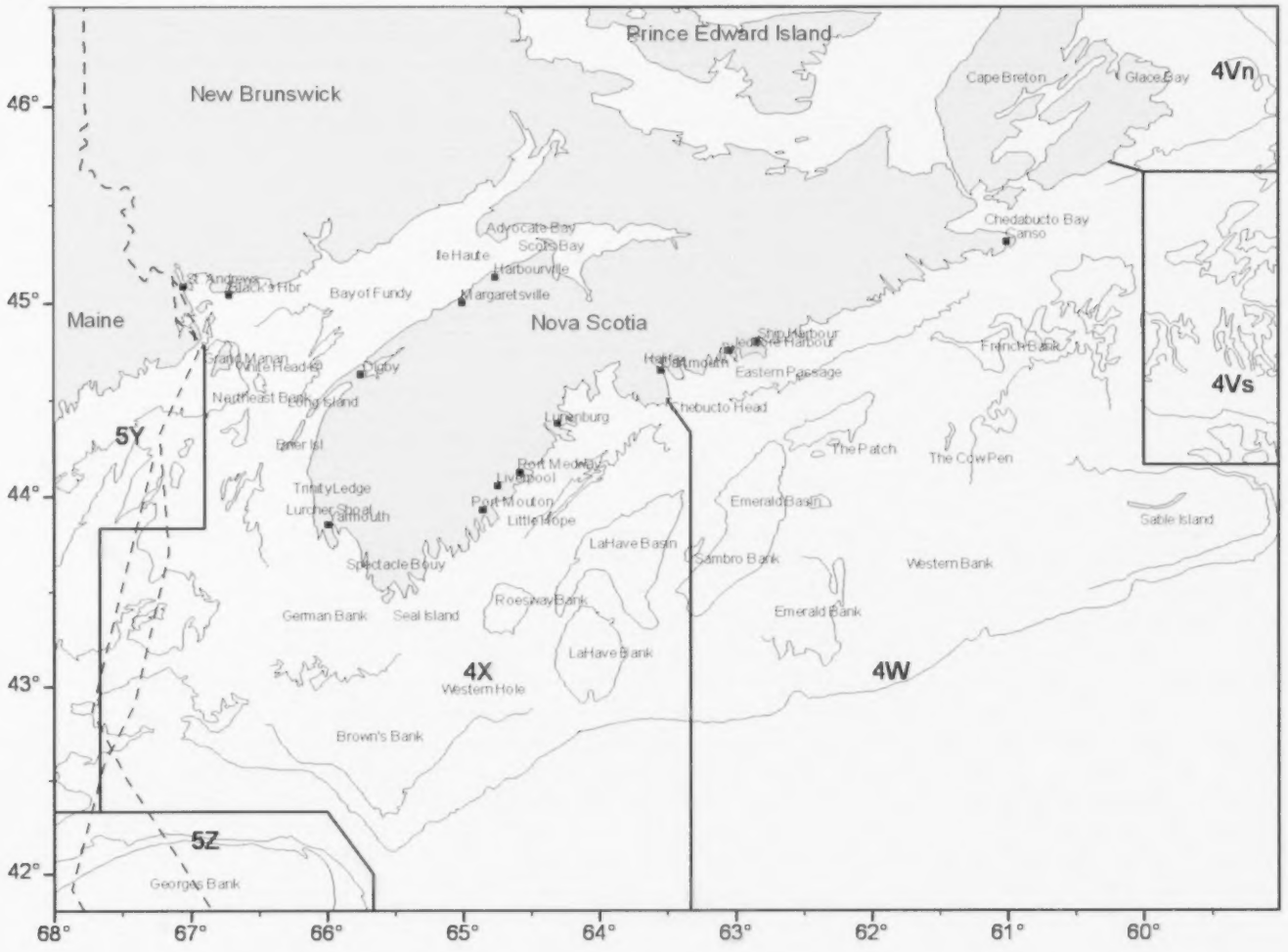
Appendix

Appendix 1. Place names and fishing locations for SWNB, Coastal Nova Scotia and Offshore Scotian Shelf.



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